# Online Appendix to: Economic Crisis and the Breakdown of Democracy in the Interwar Years: a Reassessment

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# Online Appendix to: Economic Crisis and the Breakdown of Democracy in the Interwar Years: A Reassessment

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**Abstract:** *»Online-Appendix zu: Wirtschaftskrise und demokratischer Zusammenbruch in der Zwischenkriegszeit: Eine Neubewertung«.* In this online appendix we investigate if the results presented in the main paper, *Economic Crisis and the Breakdown of Democracy in the Interwar Years: A Reassessment*, are robust to alternative modeling strategies, alternative configuration of control variables, alternative follow-up time, reduced (European) sample, alternative measure of the outcome variable, and the use of logistic regression instead of survival analysis. The robustness checks generally lend further support to our general conclusions.

**Keywords:** Democratic breakdowns, economic crisis, interwar, survival analysis.

## 1. Robustness: Alternative Modeling Strategies

To test the robustness of our findings, we replicate the results reported in Table 2 in the article using various alternative model specifications. In particular, we present a set of models with alternative configuration of control variables (see 1.1); estimate Cox models using a country's continuous years of democracy as follow-up time (rather than the time-on-study approach applied in the article, where democratic years in the interwar period constituted follow-up time; see 1.2); and restrict the analysis to a European sub-sample (1.3). For all Cox models, we test for non-proportional hazards using the established Grambsch and Therneau (1994) numerical proportionality test. Where necessary, we adjust for non-proportional hazards by including interaction terms of the problematic

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covariates with a function of survival time (see Box-Steffensmeier and Zorn 2001; Golub 2007, 2008). We test all combinations of linear, logarithmic, and squared functions of time of the violating variables, and present the model with the best fit according to Akaike's Information Criterion. As a last robustness check, we rerun the analysis applying logistic regression models with random and fixed effects (1.4). The results in these robustness tests strongly support the findings of the article. Finally, we report a set of models excluding GDP per capita as an explanatory variable to show that the lack of significance of the years of democratic experience is due to collinearity with this covariate (2).

## 1.1 Alternative Configuration of Control Variables

Table OA1 below provides variations of the models presented in Table 2 in the article featuring a slightly different set of control variables. Table OA2 provides the proportional hazards tests. The first three models employ a variable capturing the presence of strong agrarian elites with a slightly different coding; the fourth to sixth model include an additional control variable, namely a dummy variable denoting whether a country is a newly established one. As implied by the proportional hazards tests in Table OA 1, models one and five show some evidence of time-dependence regarding the effect of the crisis indicators (lagged growth and two-year average, respectively). Other than that, and apart from some minor changes to the effects of control variables, the findings confirm to the ones presented in the article.

**Table OA1**: Cox Regression Models of Interwar Democratic Breakdown, Alternative Control Variables

| | Democratic Breakdown | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Growth $_{t-1}$ | 0.029<br>(0.068) | | | -0.001<br>(0.019) | | |
| Average Growth (Two Years Preceding) | | -0.055*<br>(0.031) | | | 0.032<br>(0.031) | |
| Average Growth (Three Years Preceding) | | | -0.098***<br>(0.035) | | | -0.098**<br>(0.039) |
| Growth $_{t-1}$ * ln(T) | -0.016<br>(0.039) | | | | | |
| Average Growth (Two Years Preceding) * $T^2$ | | | | | -0.001***<br>(0.0003) | |
| GDP/cap. (ln) $_{t-1}$ | -3.566<br>(3.096) | -3.164<br>(2.832) | -3.548<br>(2.919) | -1.540**<br>(0.624) | -1.668***<br>(0.640) | -1.419**<br>(0.606) |
| Continuous Years Democratic + 1 (ln) | -1.730<br>(1.525) | -1.550<br>(1.392) | -1.549<br>(1.339) | -2.204<br>(1.908) | -1.833<br>(1.562) | -1.955<br>(1.680) |
| Presidential System | -0.232<br>(0.534) | -0.199<br>(0.532) | -0.147<br>(0.517) | -0.907<br>(0.724) | -0.839<br>(0.736) | -0.740<br>(0.639) |
| Proportional System | -0.640<br>(0.740) | -0.387<br>(0.703) | -0.185<br>(0.662) | -0.560<br>(0.614) | -0.353<br>(0.710) | -0.266<br>(0.553) |
| Agrarian Elite | | | | 0.742<br>(0.493) | 0.613<br>(0.525) | 0.603<br>(0.495) |

| *Table OA1 continued...* | | | | | | |
|---|---|---|---|---|---|---|
| Ethnic Fractionalization | -0.584<br>(0.519) | -0.396<br>(0.548) | -0.299<br>(0.539) | 0.181<br>(0.502) | 0.303<br>(0.503) | 0.350<br>(0.506) |
| World War I Loser | 1.990<br>(1.531) | 1.803<br>(1.533) | 1.491<br>(1.383) | 0.736<br>(0.473) | 0.545<br>(0.448) | 0.585<br>(0.412) |
| Agrarian Elite (Alternative Coding) | 0.279<br>(0.616) | 0.012<br>(0.539) | -0.165<br>(0.514) | | | |
| GDP/cap. (ln) t-1 * ln(T) | 0.907<br>(1.399) | 0.831<br>(1.302) | 1.015<br>(1.348) | | | |
| World War I Loser * ln(T) | -0.896<br>(0.758) | -0.852<br>(0.771) | -0.753<br>(0.696) | | | |
| Agrarian Elite (Alternative Coding) * $T^2$ | 0.010*<br>(0.005) | 0.011**<br>(0.005) | 0.012**<br>(0.006) | | | |
| New Country | | | | 1.183<br>(0.735) | 1.207*<br>(0.730) | 0.980<br>(0.753) |
| Events | 18 | 18 | 18 | 18 | 18 | 18 |
| Spells | 37 | 37 | 37 | 37 | 37 | 37 |
| Observations | 502 | 494 | 486 | 502 | 494 | 486 |
| Log Likelihood | -43.235 | -42.268 | -41.170 | -43.481 | -40.762 | -41.981 |
| LR Test | 30.701***<br>(df = 12) | 32.119***<br>(df = 11) | 33.638***<br>(df = 11) | 30.210***<br>(df = 9) | 35.130***<br>(df = 10) | 32.016***<br>(df = 9) |

Entries are Cox regression coefficients with robust standard errors (clustered on countries) in parentheses. Significance levels: * < .1, ** < .05, ***< .01.

**Table OA2**: Proportional Hazards Test of the Cox Models with Alternative Control Variables

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| Growth $_{t-1}$ | -0.255* | | | -0.256 | | |
| Average Growth (Two Years Preceding) | | -0.211 | | | -0.293* | |
| Average Growth (Three Years Preceding) | | | -0.026 | | | -0.123 |
| GDP/cap. (ln) $_{t-1}$ | 0.215* | 0.241* | 0.256* | 0.096 | 0.169 | 0.132 |
| Continuous Years Democratic + 1 (ln) | -0.054 | -0.072 | -0.056 | -0.075 | -0.068 | -0.072 |
| Presidential System | 0.103 | 0.092 | 0.143 | -0.03 | -0.022 | -0.025 |
| Proportional System | 0.009 | 0.02 | -0.017 | -0.093 | -0.037 | -0.063 |
| Agrarian Elite | | | | 0.176 | 0.155 | 0.162 |
| Agrarian Elite (Alternative Coding) | 0.204** | 0.195* | 0.214* | | | |
| Ethnic Fractionalization | -0.302 | -0.239 | -0.258 | 0.026 | 0.033 | 0.021 |
| World War I Loser | -0.26*** | -0.302*** | -0.33** | -0.117 | -0.202 | -0.229 |
| New Country | | | | -0.054 | -0.065 | -0.045 |
| Global Test | 10.914 | 10.692 | 9.893 | 5.965 | 6.806 | 4.918 |

## 1.2 Alternative Follow-Up Time: Continuous Years Democratic

The choice of appropriate follow-up time is crucial and non-trivial in event history analysis. In the article, we follow the so called 'time-on-study' approach. Here, the time a subject is on study serves as follow-up time, and the real 'age' of subjects are included into models as a control variable. In our analysis, time on study is given by the years a country had been democratic during the interwar period; the 'age' of a democratic regime is the time it had continuously been democratic up until that point. While the time-on-study approach is the most frequently ap-

plied, an obvious alternative is to use age as a time scale rather than a control. We rerun our models using this alternative time scale.

Table OA3 shows the results of proportional hazards test following Grambsch and Therneau (1994) on the naïve version of these models. We find evidence of non-proportionality associated with the variables marking presidential systems and World War I losers. We adjust the models for non-proportional hazards on these variables in table OA4.

**Table OA3**: Proportional Hazards Test of the Cox Models with Duration of Democracy as Follow-up Time

| | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Growth $_{t-1}$ | -0.142 | | |
| Average Growth (Two Years Preceding) | | -0.035 | |
| Average Growth (Three Years Preceding) | | | -0.144 |
| GDP/cap. (ln) $_{t-1}$ | 0.092 | 0.052 | 0.2 |
| Presidential System | 0.335 | 0.368* | 0.415** |
| Proportional System | 0.166 | 0.185 | 0.245 |
| Agrarian Elite | 0.187 | 0.224 | 0.304* |
| Ethnic Fractionalization | 0.002 | 0.067 | 0.117 |
| World War I Loser | -0.262 | -0.32* | -0.447*** |
| Global Test | 5.787 | 7.42 | 11.911 |

Table OA4 shows the Cox regression results with non-proportionality adjustments suggested by Table OA3. Crucially, the results regarding the crisis indicators are substantively very similar to the ones in the time-on-study models in the article. Note, that the continuous democratic years are not included anymore as an explanatory variable, because this count variable now is used as dependent variable and would thus be cancelled out as a perfect predictor.

**Table OA4**: Cox Regression Models of Interwar Democratic Breakdown, Duration of Democracy as Follow-Up Time, Model 2 Adjusted for Non-Proportional Hazards

| | Democratic Breakdown | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Growth $_{t-1}$ | -0.023<br>(0.023) | | |
| Average Growth (Two Years Preceding) | | -0.135***<br>(0.041) | |
| Average Growth (Three Years Preceding) | | | -0.211***<br>(0.071) |
| GDP/cap. (ln) $_{t-1}$ | -1.495**<br>(0.684) | -0.880<br>(0.697) | -0.667<br>(0.606) |
| Presidential System | -0.275<br>(0.474) | -4.157*<br>(2.131) | -3.064<br>(2.109) |
| Proportional System | 0.237<br>(0.901) | -0.35<br>(0.851) | 0.139<br>(0.877) |

| *Table OA4 continued...* | | | |
|---|---|---|---|
| Agrarian Elite | 0.985<br>(0.703) | 0.769<br>(0.625) | -2.139*<br>(1.300) |
| Ethnic Fractionalization | 0.118<br>(0.567) | 0.451<br>(0.428) | 0.686<br>(0.528) |
| World War I Loser | 0.582<br>(0.550) | 0.923<br>(1.425) | 0.632<br>(1.083) |
| Presidential System * ln(T) | | 1.803**<br>(0.815) | 1.355*<br>(0.820) |
| Agrarian Elite * ln(T) | | | 1.370**<br>(0.676) |
| World War I Loser * ln(T) | | -0.272<br>(0.706) | -0.251<br>(0.536) |
| Events | 18 | 18 | 18 |
| Spells | 55 | 55 | 55 |
| Observations | 680 | 668 | 656 |
| Log Lokelihood | -41.567 | -37.008 | -34.384 |
| LR Test | 7.728<br>(df=7) | 16.212*<br>(df=9) | 20.057**<br>(df=10) |

Entries are Cox regression coefficients with robust standard errors (clustered on countries) in parentheses. Significance levels: *< .1, **< .05, ***< .01.

## 1.3 European Sample

We run our models on a sample restricted to European countries only. Table OA5 provides the results of the proportional hazards tests. No violations of the proportional hazards assumption are detected. Consequently, Table OA6 present the unaltered proportional hazards models. The findings from the article regarding effects and significance levels of crisis indicators are corroborated: While the one-year lag of growth and the two-year average are not significant, the three-year average is significant at the one percent level.

**Table OA5:** Proportional Hazards Test of the Cox Models Based on European Countries

| | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Growth $_{t-1}$ | 0.175 | | |
| Average Growth (Two Years Preceding) | | 0.136 | |
| Average Growth (Three Years Preceding) | | | -0.166 |
| GDP/cap. (ln) $_{t-1}$ | 0.027 | 0.14 | 0.237 |
| Continuous Years Democratic + 1 (ln) | -0.404 | -0.425 | -0.676 |
| Presidential System | -0.054 | -0.133 | -0.109 |
| Proportional System | -0.153 | -0.123 | -0.32 |
| Agrarian Elite | 0.161 | 0.124 | 0.203 |
| Ethnic Fractionalization | 0.129 | 0.108 | 0.28 |
| World War I Loser | 0.154 | 0.128 | 0.253 |
| Global Test | 2.694 | 3.263 | 3.037 |

**Table OA6**: Cox Regression Models of Interwar Democratic Breakdown, European Countries

| | Democratic Breakdown | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Growth $_{t-1}$ | 0.025<br>(0.59) | | |
| Average Growth (Two Years Preceding) | | -0.078<br>(0.107) | |
| Average Growth (Three Years Preceding) | | | -0.338***<br>(0.121) |
| GDP/cap. (ln) $_{t-1}$ | -4.403***<br>(0.910) | -4.530***<br>(0.956) | -5.584***<br>(1.207) |
| Continuous Years Democratic + 1 (ln) | -19.520<br>(20.512) | -19.569<br>(23.304) | -18.068<br>(25.867) |
| Presidential System | 0.839<br>(0.526) | 0.968*<br>(0.521) | 1.916**<br>(0.767) |
| Proportional System | -4.926**<br>(2.413) | -4.534**<br>(2.185) | -3.759**<br>(1.590) |
| Agrarian Elite | 3.582***<br>(0.989) | 3.379***<br>(1.025) | 3.036***<br>(0.761) |
| Ethnic Fractionalization | 3.792**<br>(1.924) | 3.633**<br>(1.808) | 3.342**<br>(1.472) |
| World War I Loser | 2.161*<br>(1.270) | 1.787<br>(1.326) | 0.772<br>(0.918) |
| Events | 10 | 10 | 10 |
| Spells | 21 | 21 | 21 |
| Observations | 298 | 291 | 284 |
| Log Lokelihood | -10.372 | -10.077 | -8.235 |
| LR Test (df= 8) | 34.150*** | 34.275*** | 37.198*** |

Entries are Cox regression coefficients with robust standard errors (clustered on countries) in parentheses. Significance levels: *< .1, **< .05, ***< .01.

## 1.4 Logistic Regression Models

Also the use of alternative statistical methods in the form of random and fixed effects logistic regression lead to results that are in line with the findings based on survival analysis as the relationship between economic growth and democratic breakdown is stronger for two-year and three-year moving averages than the one year lagged growth variable, which does not achieve statistical significance.

**Table OA7**: Logistic Regression Analysis of Interwar Democratic Breakdown (Skaaning et al.), Random and Fixed Effects

| | Random Effects | | | Fixed Effects | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Growth $_{t-1}$ | -0.10<br>(3.406) | | | -1.326<br>(2.993) | | |
| Average Growth (Two Years Preceding) | | -0.90**<br>(4.263) | | | -8.355**<br>(4.466) | |

| *Table OA7 continued...* | | | | | | |
|---|---|---|---|---|---|---|
| Average Growth (Three Years Preceding) | | | -0.113** (5.213) | | | -9.874 (5.475) |
| GDP/cap. $(ln)_{t-1}$ | -3.381** (1.863) | -2.471*** (0.780) | -2514*** (0.772) | | | |
| Continuous Years Democratic + 1 (ln) | 0.523 (0.740) | 0.127 (0.300) | 0.105 (0.300) | | | |
| Presidential System | -0.239 (0.727) | -0.332 (0.591) | -0.365 (0.592) | | | |
| Proportional System | 0.724 (0.905) | 0.506 (0.647) | 0.529 (0.643) | | | |
| Agrarian Elite | 1.669* (1.158) | 1.117** (0.622) | 1.113** (0.624) | | | |
| Ethnic Fractionalization | -0.322 (0.760) | -0.192 (0.619) | -0.179 (0.612) | | | |
| World War I Loser | 0.975 (0.892) | 0.881 (0.706) | 0.771 (0.716) | | | |
| Constant | 20.444** (11.960) | 14.939*** (5.724) | 15.420*** (5.677) | | | |
| Log-Likelihood | -64.573 | -62.140 | -61.408 | -37.604 | -35.131 | -34.261 |
| Spells | 33 | 33 | 33 | 16 | 16 | 15 |
| Observations | 502 | 494 | 486 | 157 | 153 | 148 |

Entries are logistic regression coefficients with standard errors in parentheses. Significance levels: *< 0.1, **< 0.05, ***< 0.1 (one-sided).

## 2. Models Excluding GDP Per Capita

In the article, we included GDP per capita and the continuous years a country has been democratic as control variables, among others. The democratic years variable remained insignificant, although we would expect it to reduce the risk of democratic breakdown. This non-finding is arguably due to collinearity between the variables of democratic years and GDP: Older democracies tend also to be the richer countries. In order to show that democratic years do exert an effect in their own right, we exclude GDP per capita in the following set of models. Table OA8 gives the proportionality test, Table OA9 the Cox results. We see that democratic years exert a time dependent effect: In the early years of the interwar period, being an old democracy does not necessarily reduce the risk of breakdown, but in the later years it does. We can see this from a joint interpretation of the interaction term of democratic years and survival time and the component of the interaction, the coefficient of democratic years. The component is not significant, implying that democratic experience does not have an effect initially.

The interaction effect, however, is consistently significant and negative at the five percent levels throughout all models, indicating that democratic experience reduces the risk of democratic breakdown later in the interwar period. The pattern of this interesting finding should be investigated in more detail, but this online appendix is not the time and place for that. At this point, we are

content with having shown that the lack of significant of democratic years in the models in the article are due to effects of multicollinearity.

**Table OA8**: Proportional Hazards Test of Cox Regression Models of Interwar Democratic Breakdown, Excluding GDP Per Capita

| | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Growth $_{t-1}$ | -0.305 | | |
| Average Growth (Two Years Preceding) | | -0.201 | |
| Average Growth (Three Years Preceding) | | | -0.17 |
| Continuous Years Democratic + 1 (ln) | -0.194** | -0.18* | 0.0174* |
| Presidential System | -0.085 | -0.056 | 0.018 |
| Proportional System | -0.164 | -0.054 | 0.004 |
| Agrarian Elite | 0.444*** | 0.461*** | 0.489*** |
| Ethnic Fractionalization | -0.289* | -0.228 | -0.282 |
| World War I Loser | -0.415*** | -0.471*** | -0.501*** |
| Global Test | 15.188** | 15.017** | 17.822** |

**Table OA9**: Cox Regression Models of Interwar Democratic Breakdown, Excluding GDP Per Capita

| | Democratic Breakdown | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Growth $_{t-1}$ | 0.003<br>(0.017) | | |
| Average Growth (Two Years Preceding) | | -0.057**<br>(0.027) | |
| Average Growth (Three Years Preceding) | | | -0.132***<br>(0.039) |
| Continuous Years Democratic + 1 (ln) | -0.912<br>(0.610) | -0.826<br>(0.530) | -0.890<br>(0.567) |
| Presidential System | -0.903<br>(0.847) | -0.758<br>(0.805) | -0.615<br>(0.786) |
| Proportional System | -1.605<br>(1.011) | -1.276<br>(0.946) | -1.027<br>(0.860) |
| Agrarian Elite | -3.931*<br>(2.085) | -4116**<br>(2.039) | -4.480**<br>(2.123) |
| Ethnic Fractionalization | 0.746<br>(0.629) | 0.697<br>(0.472) | 0.827*<br>(0.493) |
| World War I Loser | 1.895<br>(1.354) | 1.869<br>(1.321) | 1.688<br>(1.268) |
| Years Democratic * $T^2$ | -0.038**<br>(0.018) | -0.037**<br>(0.017) | -0.036**<br>(0.017) |
| Agrarian Elite * ln(T) | 2.588**<br>(1.087) | 2.628**<br>(1.072) | 2.759**<br>(1.095) |
| Ethnic Fractionalization * $T^2$ | -0.002<br>(0.005) | 2.808<br>(1.986) | 2.521<br>(1.622) |
| World War Loser * ln(T) | -1.109*<br>(0.589) | -1.097*<br>(0.588) | -1.052**<br>(0.536) |
| Events | 18 | 18 | 18 |

| *Table OA9 continued...* | | | |
|---|---|---|---|
| Spells | 37 | 37 | 37 |
| Observations | 502 | 494 | 486 |
| Log Lokelihood | -39.508 | -38.491 | -37.261 |
| LR Test | 38.156*** (df=11) | 39.671*** (df=10) | 41.456*** (df=10) |

Entries are Cox regression coefficients with robust standard errors (clustered on countries) in parentheses. Significance levels: *< .1, **< .05, ***< .01.

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